

Geomorphometric analysis of selected Martian craters using polar coordinate transformation

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Centrally symmetric landform elements are very common features on the surface of the planet Mars. The most conspicuous ones of them are the impact craters of various size. However, a closer look on these features reveals that they show often asymmetric patterns as well. These are partially related to the geometry of the trajectory of the impacting body, but sometimes it is a result of surface processes (e.g., freeze/thaw cycles, mass movements).

Geomorphometric studies have already been carried out to reveal these peculiarities. Our approach, the application of polar coordinate transformation (PCT) very sensitively enhances the non-radial and non-circular shapes.

We used digital terrain models (DTMs) derived from the ESA Mars Express HRSC imagery. The original DTM or its derivatives (e.g. slope angle or aspect) are PCT transformed.

We analyzed the craters inter alia with scattergrams in polar coordinates. The resulting point cloud can be used directly for the analysis, but in some cases

an interpolation should be applied to enhance certain non-circular features (especially in case of smaller craters). Visual inspection of the crater slopes,

coloured by the aspect, reveals smaller features. Some of them are processing artefacts, but many of them are related to local undulations in the topography or indications of mass movements.

In many cases the undulations of the crater rim are due to erosional processes.

The drawbacks of the technology are related to the uneven resolution of the projected image: features in the crater centre should be left out from the analysis because PCT has a low resolution around the projection center.

Furthermore, the success of the PCT depends on the correct definition of the projection centre: erroneously centered images are not suitable for analysis.

The PCT transformed images are also suitable for radial averaging and calculation of standard deviations, resulting in typical, comparable crater shapes.

These studies may lead to a deeper understanding of crater shape differences related to e.g., the areographic latitude and the age of the surface.